

REMARKS

State of the claims

Claims 1-5 are pending in this application. Claims 6-28 are withdrawn.

Claims 1-5 are cancelled herein and replaced with new claims 29-33.

Issues raised in the Office Action

The Office Action asserted that a certified copy of the South African priority application and a copy of WO 00/61277 have not been filed. The preferred layout for the specification of a utility application was provided in the Office Action and the disclosure was objected to because of an informality on page 2 line 12. Correction of decimals, throughout the specification, with periods rather than commas, was requested. Claims 1-5 stand rejected under 35 USC 102(b) as being anticipated by US 3,645,700 (NAGAMURA et al), US 4,407,355 (BONN et al) and US 2,711,308 (COGAN). Claims 1-3 and 5 stand rejected under 35 USC 102(b) as being anticipated by US 5,239,945 (McCOY). Claim 1 stands rejected under 35 USC 102(b) as being anticipated by US 5,016,576 (BORNEMANN et al). The individual objections/rejections will be addressed below in the order that they are presented in the Office Action.

Support for claim amendments

New claim 29 is directed at a method of inhibiting erosion of an interior surface of a fixed bed process vessel by solid objects caused to whirl around in an annular zone against the interior surface of the vessel by fluid passing over the interior

surface. Claim 29 is limited to a method where the annular zone is above the fixed bed and is in a plane angularly displaced relative to the direction of travel of the fluid. The limitations in claim 29 have support throughout the specification, e.g. page 9 line 15 and Figure 1, and in cancelled claims 1 and 2.

Priority

A certified copy of the South African priority application (ZA 99/2726) was filed on November 2, 2001. A copy of the transmitted papers and postcard showing receipt by the USPTO are submitted herewith. A copy of WO 00/61277 is also being submitted herewith.

Specification

The Examiner indicated that corrections to the specification are required. The specification is amended herein to provide headings as required for utility applications under 37 CFR 1.77(b). Furthermore, on page 2 line 12, D2 is replaced with the specific patent number (US 5,016,576) and throughout the specification decimals have been written with periods rather than commas. The Applicant believes that the present amendments to the specification address the Examiner's requested corrections, and entry of these amendments is respectfully requested.

Drawings

Figure 2 has been corrected by replacing the top reference numeral 20 with reference numeral 22.

Claim Rejections - 35 USC § 102

Claims 1-5 stand rejected as being anticipated by NAGAMURA et al, BONN et al and COGAN and claims 1-3 and 5 stand rejected under 35 USC 102(b) as being anticipated by McCOY. Claim 1 additionally stands rejected under 35 USC 102(b) as being anticipated by BORNEMANN et al. These rejections are respectfully traversed hereinbelow in view of the cancellation of claims 1-5 and the introduction of new claims 29-35.

NAGAMURA et al deal with fluidized bed apparatus. NAGAMURA et al disclose a fluidized bed reactor having a plurality of heat conductive projections disposed from an inner surface wall of the fluidized bed reactor to limit impinging of fluidized materials within the reactor against the inner surface wall. The projections are of various shapes and at calculated intervals on the internal side wall of the reactor to provide a fluidized bed reactor which is highly resistant to wear and abrasion. NAGAMURA et al specifically teach the prevention of wear of the internal surface of the wall by contacting the projections with the fluidized solid particles, whereafter the solid particles are deflected from the projections without directly contacting the reactor wall. NAGAMURA et al are thus not concerned with a fixed bed process vessel nor with solid objects whirling around (i.e. moving round and round) in an annular zone. In contrast, the present invention is directed at a method of inhibiting

erosion of an interior surface of a fixed bed process vessel by objects caused to whirl around in an annular zone against the interior surface of the vessel by fluid passing over the interior surface. Specifically, the annular zone is above the fixed bed and is in a plane angularly displaced relative to the direction of travel of the fluid. The present invention teaches that erosion can be inhibited by providing at least one trapping formation at or in close proximity to the vessel interior surface to trap the solid objects whirling in the annular zone, thereby to inhibit erosion of the interior surface of the vessel in the annular zone. Thus, in the kind of vessels to which the method of the invention is directed, the solid objects causing erosion problems move in a plane angularly displaced, e.g. perpendicular, to the direction of travel of the fluid. This is in contrast with the normally up and down movement of particles in a fluidized bed reactor, which is thus essentially parallel to the direction of movement of the fluidizing fluid. Where high space velocities are already a concern, such as in converted fixed bed reformers, the approach of NAGAMURA et al will aggravate the situation by further reducing the volume of the reactor. Moreover, the projections as disclosed by NAGAMURA et al are not suitable for use in a high temperature, fixed bed reactor or vessel such as a reformer and the approach of NAGAMURA et al can thus not be used to solve the fixed bed process vessel related problem experienced by the Applicant, as set out on page 1 of the specification. NAGAMURA et al do not disclose or even suggest trapping solid objects whirled around in an annular zone by providing at least one formation in the annular zone to trap the whirling solid objects, as proposed by the present invention. NAGAMURA et al also provide no suggestion for inhibiting erosion of an interior surface of a fixed bed process vessel. In contrast

with NAGAMURA et al, which teach using wear formations to protect a reactor wall, the invention proposes catching the eroding solid objects before any wear or erosion as a result of the whirling solid objects can occur at all.

BONN et al provide a method for decreasing the heat, momentum and material exchange in the direct vicinity of the walls of fluidized bed reactors. In particular, BONN et al have the object of reducing the passage of heat through the reactor walls. BONN et al teach that the flow resistance to the fluid in proximity to the walls is increased to the extent that the fluidized bed in this region will not be fluidized. This can be realized with ribs extending from the walls in a horizontal direction. BONN et al are entirely silent regarding fixed bed process vessels and the whirling of solid objects in an annular zone and thus do not disclose or even suggest trapping solid objects moving rapidly round and round in an annular zone against the interior surface of a fixed bed process vessel by trapping such objects with one or more trapping formations at or in close proximity to the vessel interior surface. BONN et al are not particular as to whether or not the solid objects are deflected or trapped. However, with reference to the single drawing of BONN et al, it appears that some of the parts are arranged to deflect the solid particles, and some of the parts are possibly arranged to allow a bed or body of the solid particles to build up on these parts. As NAGAMURA et al, BONN et al are not concerned with erosion caused by solid particles whirled around in an annular zone and the comments relating to NAGAMURA et al are thus also applicable to BONN et al. None of the parts shown in the drawing of BONN et al are configured to trap small solid objects whirling in a plane arranged at an angle to the direction of travel of the fluidizing fluid. In contrast

with the solution proposed by the present invention, which traps solid particles thereby to prevent further wear or erosion, BONN et al appear to attempt to reduce the rigorousness of the movement of the particles of the fluidized bed in areas adjacent to the reactor walls, thereby principally to reduce heat transfer.

COGAN relates to liquid/gas contacting columns such as fractionating columns but is also applicable to the contacting of a finely divided solid such as sand or a catalyst with a gas, or countercurrent liquid-liquid contacting. COGAN discloses a method of mounting grid trays in such contact columns. Although the method employs the use of key bricks functioning as retaining means to retain a hold down in position, COGAN does not disclose or suggest the use of these bricks as trapping formations to trap solid objects caused to move rapidly round and round in an annular zone against the interior surface of the vessel. This is not surprising, as the problem of solid objects moving rapidly round and round in an annular zone, angularly displaced relative to the direction of travel of the fluid, does not present itself in contacting columns, where flow velocities are typically very low to ensure counter current operation or fluidization. A person skilled in the art at the time of the present invention, faced with the problem of how to inhibit erosion of an interior surface of a fixed bed process vessel by solid objects caused to move rapidly round and round in an annular zone against the interior surface of the vessel by fluid passing over the interior surface, would not turn to COGAN for inspiration, which deals with counter current processes or fluidization processes. COGAN is concerned with a mounting arrangement suitable for installing grid trays within a lined column operating under

corrosive or erosive conditions. In essence, COGAN provides a method of installing erosion or corrosion-resistant grid trays without having to cast the grid trays in large sections and which allows individual bars in the tray assembly to be replaced. The Applicant thus respectfully submits that COGAN is entirely irrelevant to the present invention and does not provide any guidance to the solution to the problem being addressed by the present invention.

McCOY deals with fluidized bed operations, and in particular with the reduction or elimination of erosion of a perimeter wall of such a fluidized bed boiler or reactor caused by impact from entrained solid particles contained within the reaction chamber. The solution proposed by McCOY is to provide the vertically disposed perimeter walls with an outward slope. Thus, McCOY deals with erosion caused by the downward velocities of entrained solid particles which strike protrusions, projections, non-uniform perimeter wall geometry or refractory interfaces on the walls. McCOY in particular deals with erosion caused by down-flowing solid particles impacting a vertically disposed water wall tube. The invention of McCOY involves the outward sloping of the vertical water wall tubes or other types of perimeter walls disposed about the reaction chamber such that once a solid particle strikes the perimeter wall it falls away therefrom. McCOY thus does not teach or suggest any method for inhibiting erosion of an interior surface of a fixed bed process vessel by solid objects caused to move rapidly round and round in an annular zone against the interior surface of the vessel by fluid passing over the interior surface, and also does not provide any information about the orientation of such an annular zone.

Furthermore, McCOY does not teach or suggest inhibiting such erosion by providing at least one trapping formation at or in close proximity to the vessel interior surface to trap solid objects whirling in the annular zone. Contrary to what has been stated by the Examiner in the Office Action, the refractory 48 is a refractory layer and nothing more and in particular does not provide trapping formations. McCOY does not refer to solid objects moving rapidly round and round in an annular zone and the refractory 48 is also not suggested by McCOY to be anything but a continuous brick perimeter wall.

BORNEMANN et al disclose a combustion chamber for combusting fine-grained fuels in a fluidized bed. The combustion chamber has a refractory lining on an inside surface of a water-cooled wall, similar to the fluidized bed boiler of McCOY. The problem being addressed by BORNEMANN et al is the abrasive action of the downward flow of gases close to the inside surface of the combustion chamber wall, particularly above the lining. This is the same problem addressed by McCOY. The method employed by BORNEMANN et al is to build up a protective body or bed of fuel solids covering the most highly endangered region of the combustion chamber wall. This is achieved by providing the lining of the combustion chamber with a cornice which is enlarged in width. During the combustion operation, a stationary bed of solids forms on the cornice. BORNEMANN et al are not concerned with erosion caused by solid particles whirled around in an annular zone against the interior surface of a fixed bed process vessel. Furthermore, the approach of BORNEMANN et al is to build up a protective body or bed over areas threatened by wear. In contrast, the

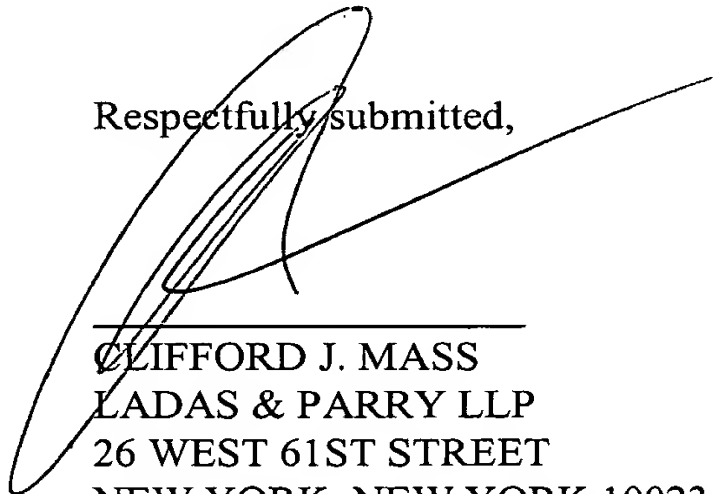
present invention proposes catching or trapping all the solid objects thereby to prevent erosion or wear and is concerned with solid objects moving around in an annular zone in a plane angularly displaced, e.g. perpendicular, to the fluid movement. Using a cornice as described in BORNEMANN et al will not solve the problem of erosion occurring in an annular band or zone, in a fixed bed process vessel. The cornice of BORNEMANN et al will not trap a solid object whirling in an annular zone against the interior surface of a vessel, in a plane perpendicular to the movement of the fluid. BORNEMANN et al thus does not disclose or even suggest the solution proposed by the present invention.

None of the prior art documents relied on by the Examiner deals with fixed bed process vessels and none of them suggests a method of inhibiting erosion of an interior surface of a fixed bed process vessel by solid objects caused to move rapidly round and round in an annular zone against the interior surface of the vessel by fluid passing over the interior surface. In particular, none of them provides any guidance for erosion problems in fixed bed process vessels where erosion takes place in an annular band or zone which is located in a plane which is angularly displaced relative to the direction of travel of the fluid. The presently claimed invention in contrast provides an elegant and inventive solution to the problem of erosion caused by solid objects whirling around in an annular zone against the interior surface of a fixed bed process vessel. In view of the foregoing, the Applicant submits that claim 29, and all the claims depending from claim 29, are directed to a patentable invention and respectfully requests that the § 102(b) rejections be withdrawn.

Conclusions

The points and concerns raised by the Examiner in the Office Action have been addressed in full and it is respectfully submitted that this application is in condition for allowance. An early notice of allowance is earnestly solicited and is believed to be fully warranted.

Respectfully submitted,



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IN THE DRAWINGS:

Please replace the drawing sheet for Figure 2 with the attached replacement sheet for Figure 2. A marked copy of the original sheet is also attached to show the change being made: correction of a redundant reference numeral.

